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SUBSTRATE ASSEMBLING APPARATUS

[Abstract]

PURPOSE: To obtain an apparatus, by which substrates can be pasted together with sealant with no introduction of dust during assembling work.

CONSTITUTION: A table 4, which travels between sealant drawing station S1 and substrate pasting station S2, is provided. Further, first substrate 13 is mounted on a stage 5, which travels on the table 4 normal to the travelling

direction of the table 4, so as to emit sealant from an emitter, on which a downward directing nozzle tip is provided, and simultaneously move the stage to normal direction in order to draw pattern in S1. Second substrate 14 is horizontally hung with suction table 15 in S2. By moving the table 4 to S2, the first substrate is arranged below the second substrate. Finally, by narrowing the opposing interval between both the substrates, the substrates are pasted together.

[Claims]

[Claim 1]

An apparatus for assembling substrates including: a sealing material drawing station, a table movable between a substrate-bonding station; a nozzle installed at the sealing material drawing station and discharging a sealing material; a stage installed on the table, on which a first substrate is mounted, and movable in a perpendicular direction, a means for drawing the sealing material with a desired pattern on the first substrate by moving the stage in the perpendicular direction while discharging the sealing material from the nozzle; means for supporting a second substrate at an upper side of the first substrate mounted on the stage in parallel with the first substrate when the table is moved onto the substrate-bonding station, and a means for bonding the both substrates by narrowing a facing gap between the first and second substrates disposed to be parallel by means of the supporting means.

[Claim 2]

The apparatus of claim 1, wherein the stage moves the first substrate mounted thereon in a further upward direction.

[Claim 3]

The apparatus of claim 1, wherein a ceiling portion and a portion of a side is covered by a net cover.

[Title of the Invention]

SUBSTRATE ASSEMBLING APPARATUS

[Detailed description of the Invention]

[Field of the Invention]

The present invention relates to a substrate assembling apparatus and, more particularly, to an apparatus for assembling substrates capable of extremely approaching two sheets of substrates such as a liquid crystal display panel and preventing introduction of dust during an assembly process.

[Description of the Prior art]

A related art liquid crystal display (LCD) panel is constructed such that two sheets of glass substrates with a transparent electrode or a thin film transistor (TFT) array attached thereon are bonded with a sealing material with a gap of about a few μm therebetween and liquid crystals are injected into an accordingly formed closed space and then sealed. In this case, the substrate can be moved while a resistance paste is being discharged thereon from a nozzle for installing the sealing material on the glass substrate to draw a certain pattern to form a resistance pattern. A Japanese Laid Open Publication 2-52742 discloses a related art. In addition, in a assembling substrates of the LCD panel, the sealing material-coated glass substrate is moved onto a bonding operation table by using a returning means, the two sheets of glass substrates are aligned in their plane direction manually, and spacer particles are included in the sealing material,

so that the two substrates are bonded with an extremely narrow gap of a few μm therebetween.

[Problems to be solved by the Invention]

In the related art LCD panel, the fine transparent electrode and the TFT array are installed on the glass substrate, pixels formed according to the construction are extremely small. Thus, if dust is collected on the glass substrate during an assembling operation and introduced in the closed space, the portion with dust results in a defective pixel. The defective portion appears as a black point in a black and white display panel, and in a color display panel, the defective portion becomes one of red, green and blue colors and displayed on the screen, an image is degraded. In order to apply the sealing material on the glass substrate, a technique as disclosed in the Japanese Laid Open Publication 2-52742 can be used in which the resistance paste is discharged in a non-contact state between the substrate and the nozzle, the substrate is moved, on which the certain resistance pattern is drawn, and then, the nozzle is fixed, so that dust can be hardly collected on the substrate. In this case, however, there is no mention about how the substrate is handled after the drawing of the resistance pattern. Another problem is that, in assembling the substrates of the LCD panel, since the sealing material-installed glass substrates are moved onto the bonding table by using the returning means and the two glass substrates are aligned manually and then bonded, dust can be collected on the glass substrates during the assembly operation and degree of introduction of dust into the closed space is quite high.

Therefore, an object of the present invention is to provide an apparatus for assembling substrates with a simple construction capable of bonding substrates without dust in the process of applying the sealing material on the substrate such as the LCD panel, closely approaching two substrates, and bonding them.

[Means for solving the problem]

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided an apparatus for assembling substrates including: a sealing material drawing station, a table movable between a substrate-bonding station; a nozzle installed at the sealing material drawing station and discharging a sealing material; a stage installed on the table, on which a first substrate is mounted, and movable in a perpendicular direction, a means for drawing the sealing material with a desired pattern on the first substrate by moving the stage in the perpendicular direction while discharging the sealing material from the nozzle; means for supporting a second substrate at an upper side of the first substrate mounted on the stage in parallel with the first substrate when the table is moved onto the substrate-bonding station, and a means for bonding the both substrates by narrowing a facing gap between the first and second substrates disposed to be parallel by means of the supporting means. In addition, according to the apparatus for assembling the substrates, the first substrate mounted on the stage can be moved more in the up/down direction and a ceiling portion and a portion of a side circumference of the apparatus are covered with a net.

[Operation]

In the substrate assembling apparatus, in the process where the sealing material drawing station draws a sealing material pattern on the first substrate by discharging the sealing material from the nozzle while moving the stage in the perpendicular direction, dust is not dropped on the first substrate. In addition, since there is nothing moved at an upper side of the first substrate, no dust is dropped on the first substrate, and after the sealing material drawing, when the first substrate mounted on the stage is moved onto the substrate-bonding station and disposed at a lower side of the second substrate, a returning means is not used and there is nothing moved at an upper side of the first substrate, so no dust is dropped on the first substrate. Moreover, in the process of bonding the both substrates, since the both substrates disposed to be parallel up and down are bonded by narrowing the facing gap therebetween, there is nothing move between the both substrates, and thus, no dust is dropped on the first substrate. As a result, because dust is not dropped on the first substrate in any process of the assembly operation, no dust is introduced into the space formed by bonding the both substrates by means of the sealing material and the construction of the apparatus can be simplified. In addition, the stage can move the first substrate in the vertical direction, the apparatus can have simpler construction, and since the ceiling portion and a portion of the side circumference of the apparatus are covered with the net, the apparatus is left in a down-flow type clean room so that dust can be discharged externally from the apparatus according to an air flow.

[Embodiment of the invention]

The embodiment of the present invention will now be described with reference to Figures 1 to 3.

Figure 1 is a front view of an apparatus for assembling an LCD panel in accordance with one embodiment of the present invention.

As shown in Figure 1, the apparatus for assembling an LCD panel 1 includes a sealing material drawing station S1 and a substrate bonding station S2. The both stations S1 and S2 can be positioned to be adjacent. A mounting plate 3 supported by a support 2a is placed at an upper side of a base 2. A rail 7 is provided on the base 2, extending over the both stations S1 and S2. A stage moving table 4 is moved on the rail 7 between the both stations S1 and S2 in a horizontal direction on the drawing by a stage driving motor 6. An XYϕ stage 5 is mounted on the table 4, on which a lower absorption table 8 supporting a first glass substrate 13 is mounted. The XYϕ stage 5 will now be described. When the first glass substrate is horizontally mounted, it is horizontaily moved in X and Y axes direction and horizontaily rotated in a ϕ direction. If the first glass substrate 13 is precisely disposed in the X and Y directions, it does not need to be moved in the ϕ direction.

A Z-axis moving table 10 moving up and down by a Z-axis driving motor 9 is installed at the mounting plate 3, facing the rail 7, of the sealing material drawing station S1. A sealing material discharger 12 having an optical non-contact displacement gauge (변위계) 11 and a nozzle is installed at the table 10. A front end of the nozzle points toward the first substrate positioned at its lower side. A pressing driving mechanism 17 is

mounted on a mounting plate 18 supported by a column 2b at an upper side of the mounting plate 3, facing the rail 7, of the substrate-bonding station S2. The driving mechanism 17 and the pressing absorption table 15 are moved up and down with a ball screw 17a interposed therebetween. The pressing absorption table 15 supports the second glass substrate 14 at its lower surface through vacuum absorption so as to be parallel with the first glass substrate 13 in a manner of being disposed horizontally. Holes 15a and 15b are formed on the table 15, and an image recognition cameras 16a and 16b each having a CCD are installed at portions of the mounting plate 3 corresponding to the holes 15a and 15b of the table 15. The cameras 16a and 16b point downwardly so as to detect an object that may exist at a lower side of the second glass substrate 14 through the holes 15a and 15b of the table 15. In addition, a controller for controlling each driving unit is also installed in the LCD panel assembling apparatus.

Figure 2 is a schematic view for showing an operation of the LCD panel assembling apparatus of Figure 1.

The operation and function of the LCD panel assembling apparatus of Figure 1 will now be described.

With reference to Figure 2, the cases where the XYϕ stage 5 and the lower absorption table 8 are moved to the bonding stage S2, it is indicated by the two-dot long line, and 5Φ and 8Φ are given to each case.

When the moving table 4 is moved by the stage driving motor 6 of Figure 1 on the rail 7 positioned on the base 2 to the first bonded station S2, the second glass substrate 14 is mounted on the lower absorption table 8Φ positioned on the XYϕ stage 5Φ with an adapter 14a interposed

therebetween. The adapter 14a is to prevent the lower surface of the second glass substrate 14 from contacting with the lower absorption table 8Φ and has a shape of frame supporting the circumference of the second glass substrate 14. The cameras 16a and 16b read an alignment mark (not shown) formed at the second glass substrate 14 and control the XYϕ stage 5Φ so that the second glass substrate 14 can be plated at a certain position of the bonding station S2.

And then, the pressing driving mechanism 17 and the pressing absorption table 15 are moved downwardly, supporting the second glass substrate 14 in such a manner that the second glass substrate 14 is hanging horizontally on the table 15, and in this state, the second glass substrate 14 is moved upwardly by the medium of the pressing absorption table 15 by using the driving mechanism 17 so as to be in standby and the adapter 14a is removed. Through this operation, even if dust falls, it can be dropped on the second glass substrate which does not need to avoid dust, without causing a problem.

Next, the first glass substrate 13 is mounted on the lower absorption table 8Φ, and the XYϕ stage 5Φ is controlled such that the first glass substrate 13 can be placed at a certain position of the bonding station S2. Herein, when aligning of the first glass substrate 13 is finished, the XYϕ stage 5Φ is moved toward the sealing material drawing station S1. And then, at the sealing material drawing station S1, the Z-axis driving motor 9 of Figure 1 is controlled by an output of the optical non-contact displacement gauge 11 positioned on the Z-axis moving table 10, and a gap between the front end of the nozzle of the sealing material discharger 12 positioned on

the Z-axis moving table 10 and the surface of the first substrate 13 positioned on the lower absorption table 8. Through this operation, the nozzle movement distance of the sealing material discharger 12 for setting the gap is small, and thus, no dust is generated. If dust is strongly desired to be avoided against glass, as indicated by the long dotted line as shown in Figure 2, a driving unit including the Z-axis moving table 10 of the sealing material discharger 12 can be closed and the closed space cab be vacuumized.

The sealing material is discharged from the nozzle of the sealing material discharger 12 while moving the XYϕ stage 5 in the X and Y directions according to a drawing pattern, thereby applying the sealing material on the first glass substrate 13. The sealing material pattern desired to be drawn is not shown. In addition, a PC drawing pattern can be stored by a controller (not shown) so that the same drawing pattern can be coated on several sheets of the first glass substrate 13. Also, various drawing patterns can be obtained by changing input data. Through this operation, there is nothing moved at an upper side of the first glass substrate 13 during the sealing material discharging and drawing, no dust can be dropped on the first glass substrate.

Thereafter, after the sealing material is completely coated, the v\ XYϕ stage 5 is moved to the bonding station S2 again and then first positioned right below the pressing absorption table 15 supporting the second glass substrate 14. Also, in this operation, the first glass substrate 13 is disposed at a lower side of the second glass substrate 14 for the XYϕ stage 5 and the lower absorption table 8 without using any returning means, so there is

nothing moved at an upper side of the first glass substrate 13 and thus no dust is dropped on the first glass substrate even when the first glass substrate 1 is moved. In addition, because another returning means is not required, the construction of the apparatus is simple.

The cameras 16a and 16b is focused on the alignment mark (not shown) of the first glass substrate 13 to read it to control driving of the XYϕ stage 5Φ, and then, the first and second glass substrates are roughly aligned.

And then, the pressing driving mechanism 17 of Figure 1 and the pressing absorption table 15 are gradually moved downwardly, so that when an alignment mark (not shown) of the second glass substrate 14 can be read by the cameras 16a and 16b, the XYϕ stage 5Φ is controlled to be driven to precisely align the first and second substrates 13 and 14. And then, the pressing absorption table 15 is lowered more gradually, and then, the two glass substrates 13 and 14 are bonded with the sealing material. Through this operation, in bonding the glass substrates 13 and 14, there is nothing moved between the glass substrates 13 and 14, so no dust is dropped on the first glass substrate 13.

As mentioned above, because there is no dust dropping on the first glass substrate in any process, no dust is introduced into the space formed by bonding the glass substrates with the sealing material. In addition, the sealing material drawing process, the substrates bonding process and the moving process between both stations of the sealing material drawing and the substrate bonding can be processed by simply controlling the order, so that the series of operations can be programmed by a controller and then

controlled by a PC.

Figure 3 is a perspective view of an exterior of the LCD panel assembling apparatus of Figure 1.

As shown in Figure 3, net covers 19 and 20 are installed at a lower portion of a front surface and a rear surface of the LCD panel assembling apparatus 1, shielding covers 21 and 22 are installed at both sides of the LCD panel assembling apparatus, and a control panel 23 of a controller (not shown) of each driving unit is installed next to the shielding cover 22. Also, a net cover 24 is installed at the ceiling, and a transparent cover 25 made of an acrylic material is installed at an upper portion of the front side so that the interior can be viewed.

The LCD panel assembling apparatus is placed in a down-flow type clean room. When air indicated by an arrow 'A' flows, the air flows through the net cover 24 of the ceiling and then flows out of the lower net covers 19 and 20 of the front and rear surfaces of the apparatus 1, and thus, dust in the apparatus 1 can be discharged externally owing to the air flow.

The substrate assembling apparatus of the present invention can be also performed as follows.

In a first aspect of the present invention, a Z-axis moving table is installed on the XYϕ stage 5, the sealing material discharger 12 having the nozzle and the optical non-contact displacement gauge 11 are directly fixed at the mounting plate 3 of the sealing material drawing station S1, and the gap between the front end of the nozzle of the sealing material discharger 12 and the first glass substrate 13 positioned on the lower absorption table 8 is set at the Z-axis moving table. In this aspect of the present invention, since

there is no moving unit at an upper side of the first substrate 13 mounted on the lower absorption table 8 at the sealing material drawing station S1, there is no dust dropping onto the first substrate 13.

In a second aspect of the present invention, the pressing driving mechanism 17 and the mounting plate 18 are omitted at the substrate bonding station S2, the absorption table 15 of the second substrate 14 is directly fixed on the mounting plate 3, the Z-axis moving table is installed at the XYϕ stage 5, the second substrate 14 is lifted to the Z-axis moving table and fixedly absorbed on the absorption table 15, and three sheets of substrates 13 and 14 are bonded.

In this aspect of the present invention, there is no moving part at an upper side of the absorption table 15 at the substrate bonding station S2 and there is no dust dropping onto the first substrate 13. In addition, since the pressing driving mechanism 17 and the mounting plate, 18 are omitted, the construction of the apparatus can be more simplified.

A third aspect of the present invention features that the substrate absorption function is give to the XYϕ stage 5, and the lower absorption table 8 is omitted.

In this aspect of the present invention, members to be loaded on the stage moving table are reduced in number, and thus, running of the stage moving table 4 can be performed lightly thanks to the light weight.

In a fourth aspect of the present invention, according to the fixing characteristics of the sealing material, an ultraviolet irradiation means for solidifying the sealing material is installed either at the sealing material drawing station S1 or at the substrate bonding station S2. In terms of its

shape, an additional unit for solidifying the sealing material is not required, so the construction of the apparatus can be simplified.

[Effect of the invention]

As so far described, in the assembling operation of the substrate assembling apparatus for approaching two substrates such as an LCD panel and bonding them with the sealing material, the substrates can be bonded without dust and the construction of the apparatus can be simplified.

[Description of drawings]

Figure 1 is a front view of an apparatus for assembling an LCD panel in accordance with one embodiment of the present invention;

Figure 2 is a schematic view for showing an operation of the LCD panel assembling apparatus of Figure 1; and

Figure 3 is a perspective view of the exterior of Figure 1.